Amendments to the Specification:

Please replace the title at page 1, lines 3-5 with the following:

C1

A METHOD FOR SMOOTHING A BARRIER LAYER IN A MAGNETORESISTIVE EFFECT SENSOR BY SMOOTHING A LOWER LAYER, AND A SENSOR HAVING A SMOOTHED LOWER LAYER

Please replace the paragraph beginning at page 1, line 19, with the following rewritten paragraph:

C2

An MR sensor detects a magnetic field signal by converting it to a change in resistance as a function of the strength and direction of magnetic flux sensed by a reading element. This MR sensor ~~of the~~ according to the prior art operates based on the anisotropic magnetoresistive (AMR) effect, whereby one component of the resistance of the reading element is proportional to cosine of the angle between the direction of magnetization and the direction of the detected current flowing in the element.

Please replace the paragraph beginning at page 2, line 8, with the following rewritten paragraph:

C3

Additionally, there is ~~citing of~~ a more prominent magnetoresistive effect, in which the change in resistance of a laminated magnetic sensor is attributed to spin-dependent transmission of conduction electrons between magnetic layers via a non-magnetic layer, and to spin-dependent scattering at the accompanying layer boundary.

Please replace the paragraph beginning at page 3, line 22, with the following rewritten paragraph:

C4

In the Japanese Unexamined patent publication (KOKAI) No. 4-103014, related to a patent application filed August 22, 1990, there is language describing a ferromagnetic tunnel effect film, wherein in a ~~multiplayer~~ multilayer ferromagnetic tunnel junction element in which an intermediate layer is interposed between ferromagnetic layers, and wherein a bias magnetic field is applied to at least one ferromagnetic layer from an anti-ferromagnetic material.

Please replace the paragraph beginning at page 6, line 5 with the following rewritten paragraph:

C5

Additionally, there is a reduction ~~is~~ in resistance change attributed to the thinning of the effective thickness of the barrier layer. With a decrease in the effective film thickness also comes an increase in the ferromagnetic coupling passing from the fixed layer to the free layer via the barrier layer.

Please replace the paragraph beginning at page 6, line 18, with the following rewritten paragraph:

C6

In addition to the above, in the Japanese examined patent publication (KOKOKU) No. 8-21166, the Japanese Unexamined patent publication (KOKAI) No. 5-217123, and Japanese patent number 2651015, there are disclosures of the configuration of magnetic heads. However, while the structure of these heads is described, there is in no case a disclosure of a technical configuration that ~~smoothes~~ smooths the surface of the film component directly below the barrier layer in a compound-type magnetoresistive effect element.

Please replace the paragraph beginning at page 9, line 10, with the following rewritten paragraph:

C7

A fourth aspect of the present invention is a method for manufacturing a magnetoresistive effect sensor wherein a magnetoresistive effect film having a basic configuration that is either the combination of a free layer, a barrier layer formed on the free layer, and a fixed layer formed on the barrier layer, or a combination of a fixed layer, a barrier layer formed on the fixed layer, and a free layer formed on the barrier layer, which is formed on a lower conductor layer so as to make contact via a base layer or directly, without an intervening base layer, on a conductor layer, the lower conductor layer being made of either an amorphous material or a microcrystalline material.

Please replace the paragraph beginning at page 10, line 4, with the following rewritten paragraph:

C8

In particular, the constitution of the present invention was adopted by knowing the extreme importance of forming the ~~a~~ layer directly below the barrier layer so as to be as smooth as possible and flat.

Please replace the paragraphs beginning at page 15, line 15, and continuing to page 17, line 14, with the following rewritten paragraphs:

C9

In this configuration, there is a lamination onto a substrate 40 of a lower shield 1, a lower gap ~~layer 3~~ layer 2, and a lower conductor layer 22. Over this are successively laminated a base ~~layer 3~~ layer 8, a free ~~layer 8~~ layer 3, and a barrier layer 4.

In the part between the vertical bias layers 9 at the left and right on the barrier layer 4 are formed a fixed layer 5/fixing layer 6/upper layer 7, these being patterned as shown in the drawing.

C 9, 1 con

An insulation ~~layer~~ layer 11 is disposed in the area surrounding the patterned barrier layer 4/fixed layer 5/fixing layer 6/upper layer 7. Further, an upper electrode layer 17, an upper gap layer 18, and an upper shield layer 19 are laminated thereonto.

In this configuration, the base ~~layer 3~~ layer 8/free ~~layer 8~~ layer 3/barrier layer 4/fixed layer 5/fixing layer 6/upper layer 7 constitute a magnetoresistive effect film 20. Where magnetoresistive effect film 20 includes base layer 8/free layer 3 as part of the film, base layer 13/free layer 10 are shown separately as patterned on vertical bias layer 9, as shown on Figs. 1, 4 and 5.

In this structure, should an electrical current flow from the upper electrode 17 toward the lower electrode 22 as shown in the drawing, the current will pass in sequence from the upper electrode 17 to the upper layer 7, the fixing layer 6, the fixed layer 5, the barrier layer 4, the free ~~layer 8~~ layer 3, and the base ~~layer 3~~ layer 8, and finally to the lower electrode layer 22.

When this occurs, the vertical bias layer 9 does not contribute to the manner in which the current flows. Because the vertical bias pattern is disposed so as to be in contact with the free ~~layer~~ layer 10 pattern, the vertical bias thereof is sufficiently applied to the free layer. By using this structure, therefore, it is possible to have a sensing current flow properly through the magnetoresistive effect film part, and to properly apply vertical bias to the free ~~layer~~ layer 3.

While this embodiment shows the example in which both an upper gap 18 and lower ~~gap 3~~ gap 2 are provided, it is possible to omit one of these gap layers.

Additionally, while it is possible to use a structure in which a separate base ~~layer~~ layer 8 is additionally provided between the lower electrode layer 22 and the free ~~layer 8~~ layer 3, there are cases in which the lower base layer 8 is omitted.

As is described below, in another embodiment the lower conductor layer 22 is omitted.

C9 cont

While this embodiment of the present invention shows the patterning done up to the barrier layer lower edge when patterning is done of the magnetoresistive ~~effec~~ effect film 20, it is possible to appropriately select from the upper edge of the barrier layer 4 up to where on the lower edge of the free layer 3 the patterning is to be done. Additionally, it is not necessary to have the lower base layer 13 and free layer 10 on the vertical bias ~~film~~ film layer 9.

Next, with regard to another embodiment of the magnetoresistive effect sensor 30 according to the present invention, in the structure shown in Fig. 3, a lower conductor ~~layer 33~~ layer 22 is formed on a lower shield 1 formed on the substrate 40, and over this is formed the pattern of the magnetoresistive effect film 20.

Please replace the paragraphs beginning at page 18, line 11, and continuing to page 18, line 21, with the following rewritten paragraphs:

C10

Additionally, although ~~this~~ the Fig. 3 embodiment ~~show~~ shows a structure in which the lower ~~shied~~ shield 1 and lower conductor layer 22 are in contact, it is possible to omit the lower conductor layer 22, and possible to provide a lower gap layer (as shown by item 2 on Fig. 1) between these two elements.

~~As shown in Fig. 1, it~~ It is possible in the embodiment shown in Fig. 3 to provide an upper electrode layer (as shown by item 17 on Fig. 1) between the upper shield 12 and the upper protective layer 7 on the magnetoresistive effect film 20, and it is further possible to provide an upper gap layer (as shown by item 18 on Fig. 1) between the upper electrode layer (as shown by item 17 on Fig. 1) and the upper shield 12.

Please replace the paragraphs beginning at page 18, line 24, and continuing to page 19, line 14, with the following rewritten paragraphs:

C11

Another configuration of a magnetoresistive effect film 20 in this embodiment is formed by the base layer 14/free ~~layer 8~~ layer 3/barrier layer 4/fixed layer 5/fixing layer 6/upper layer 7.

Yet another embodiment of the magnetoresistive effect sensor 30 according to the present invention is a structure wherein the upper ~~and lower gap layers 2 and 18 are both removed~~ gap layer 18 is removed from the structure of Fig. 1, as shown in Fig. 4, and a structure wherein there is further omission from the structure of Fig. 1 of the upper shield layer 19 and the lower gap 2, as shown in Fig. 5, the upper shield layer ~~12~~ serving as an upper electrode layer 12.

Fig. 6 is a variation on Fig. 5, wherein the base layer 8 and free layer 3 are patterned onto the vertical bias ~~pattern~~ layer 9 pattern.

Fig. 8 is a variation on Fig. 6, wherein in the TMR film pattern 20, because complete patterning of the film 20 is done to the lowermost edge of the free layer 3, the free layer 3 and vertical bias layer 9 are not in contact, which is different from the above-noted embodiments.

Please replace the paragraph beginning at page 21, line 8, with the following rewritten paragraph:

C12

Additionally, it is possible to omit the base ~~layer~~ layer 14 of the magnetoresistive effect film in this embodiment.

Please replace the paragraph beginning at page 23, line 23, with the following rewritten paragraph:

C13

As indicated below, the following elements are primary candidates for elements to use in each layer.

Base

Alumina-TiC, ~~Sic~~SiC, alumina, alumina-TiC/alumina, SiC/alumina

Lower Shield Layer

A single or multilayer film or mixture of CoZr, CoFeB, CoZrMo, CoZrNb, CoZr, CoZrTa, CoHf, CoTa, CoTaHf, CoNbHf, CoZrNb, CoHfPd, CoTaZrNb, CoZrMoNi alloy, FeAlSi, or metal nitride.

Please replace the paragraph beginning at page 26 line 6, with the following rewritten paragraph:

C14

- Base/base layer/laminate of N repetitions (where N is 1 or greater) of (fixed layer/first MR enhancement layer/barrier layer/second MR enhancement layer/~~free~~ free layer/barrier layer)/fixed layer/protective layer

Please replace the paragraph beginning at page 27 line 15, with the following rewritten paragraph:

C15

Primary candidates are single or ~~mutlilayer~~ multilayer film or mixture of Ti, Vi, Cr, Co, Cu, Zn, Y, Zr, Nb, Mo, Tc, Ru, Rh, Pd, Ag, Hf, Ta, W, Re, Os, Ir, Pt, Au, Si, Al, Ti, Ta, Pt, Ni, Co, Re, and V or a laminate with a single or multilayer film, or mixture of these with oxides and nitrides of Ti, Vi, Cr, Co, Cu, Zn, Y, Zr, Nb, Mo, Tc, Ru, Rh, Pd, Ag, Hf, Ta, W, Re, Os, Ir, Pt, Au, Si, Al, Ti, Ta, Pt, Ni, Co, Re, and V.

Please replace the paragraph beginning at page 28 line 21, with the following rewritten paragraph:

c16

It is possible to use NiFe, CoFe, NiFeCo, FeCo, CoFeB, CoZrMo, CoZrNb, CoZr, CoZrTa, CoHf, CoTa, CoTaHf, CoNbHf, CoZrNb, CoHfPd, CaTaZrNb, and ~~CoZrMoNi~~ CoZrMoNi alloy or an amorphous material as a fixed layer.

Please replace the paragraph beginning at page 29 line 7, with the following rewritten paragraph:

c17

Other primary candidates ~~threof~~ thereof are PtMn or material in which Ti, V, Cr, Co, Cu, Zn, Y, Zr, Nb, Mo, Tc, Ru, Rh, Pd, Ag, Hf, Ta, W, Re, Os, Ir, Pt, Au, Si, Al, Ti, or Ta are added to PtMn.

Please replace the paragraph beginning at page 33 line 5, with the following rewritten paragraph:

c18

After forming the film, heat treating was performed for 5 hours at 270°C in a magnetic field of 500 Oe in a direction perpendicular to the direction of the magnetic field at the time of film formation. The following were used as the various elements of the head.

Base

Alumina-TiC having a thickness of 2 mm, onto which is ~~laminted~~ laminated alumina to a thickness of 3 mm